Status of Shoebill *Balaeniceps rex* in Malagarasi, Tanzania

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Statut du Bec-en-sabot du Nil *Balaeniceps rex* à Malagarasi, Tanzanie. En Tanzanie, le site de Malagarasi est le plus important pour la survie du Bec-en-sabot du Nil *Balaeniceps rex* et est supposé abriter la plus grosse population de l'espèce en dehors du Sudd au Soudan. Les tentatives pour estimer la taille de cette population semblent cependant avoir résulté en de considérables surestimations. L'examen de la littérature et les comptages aériens réalisés en novembre 2001 par les auteurs suggèrent que la population de Malagarasi ne comprendrait que quelques centaines d'oiseaux seulement. Les comptages aériens de 2001 ont également montré que l'étendue de certaines zones humides à Malagarasi avait été sérieusement surestimée. Les auteurs considèrent donc que le changement du statut de conservation du Bec-en-sabot de 'Quasi-menacé' en 'Vulnérable' (espèce dont la population entière compte moins de 10.000 individus) est justifié. Le Bec-en-sabot du Nil a une répartition restreinte, s'étendant du sud du Soudan au nord de la Zambie et de la République Démocratique du Congo orientale à la Tanzanie occidentale, et l'espèce est menacée dans tous les sites importants, comme les marais du Sudd, Malagarasi, Bangweulu et en Ouganda. Un protocole est proposé pour les futurs comptages aériens du Bec-en-sabot, afin de définir les zones principales occupées par l'espèce et d'effectuer des comptages complets.

Summary. The Malagarasi ecosystem is the stronghold for Shoebill *Balaeniceps rex* in Tanzania and is believed to host the largest population of the species outside the Sudd in Sudan. However, attempts to establish population numbers in Malagarasi seem to have resulted in considerable over-estimations. A review of the literature and aerial counts in November 2001 by the authors suggest that the Malagarasi population might comprise 100 or a few hundred birds only. The aerial survey in 2001 also revealed that previous estimates of the extent of certain wetland habitats in Malagarasi have been significantly overestimated. The authors therefore support the upgrade of the conservation status of Shoebill from Near Threatened to Vulnerable, i.e. with a total population of less than 10,000 individuals. Shoebill has a limited range from southern Sudan to northern Zambia and from eastern DR Congo to western Tanzania, and the species is threatened at all its main localities e.g. the Sudd swamps, Malagarasi, Bangweulu and in Uganda. A design for future aerial surveys of Shoebill is proposed focusing on identifying core areas for the species and comprehensive counts.

Shoebill *Balaeniceps rex* has a discontinuous distribution, restricted mainly to a few large permanent wetlands from southern Sudan, Uganda, eastern DR Congo and northern Zambia to western Tanzania. Its world population was estimated at only *c.*1,500 individuals two decades ago (Brown *et al.* 1982), and at *c.*11,000 (Elliott 1992) or 12,000–15,000 in 1986 (Collar 1994, Rose & Scott 1994, BirdLife International 2000). This apparent increase was due to the use of new census methods, including aerial surveys. In 2002, however, the population was estimated at 5,000–8,000 birds and declining, based on new information (Delany & Scott 2002).

The Tanzanian population was estimated at maximum 2,500 individuals, based on aerial surveys by the Tanzania Wildlife Conservation Monitoring (TWCM, now Conservation Information Centre under Tanzania Wildlife Research Institute (TAWIRI) between 1990 and 2000 (Tanzania Wildlife Conservation Monitoring 1991, 1998, 1999 and unpubl., Jones & Hill 1994a, Collar 1994, Baker 1996, BirdLife International 2000). The prime locality for Shoebill in Tanzania are the permanent swamps and inundated floodplains along the Moyowosi, Nikonga, Kigosi, Igombe, Ugalla and Malagarasi rivers (hereafter: the Malagarasi) forming a mosaic of wetlands in western Tanzania (Fig. 1).

The Malagarasi was listed as a Ramsar site in August 2000, when Tanzania ratified the Convention on Wetlands (Ramsar 1971), and the

Figure 1. Map of Tanzania showing protected areas and the Malagarasi-Muyovozi Ramsar sites.
Carte de la Tanzanie indiquant les aires protégées et le Site Ramsar Malagarasi-Muyovozi.

designated area covers *c.*32,500 km^2. The main rationale was that it supports 'appreciable numbers of rare, vulnerable or endangered species' such as Shoebill, Wattled Crane *Bugeranus carunculatus*, Sitatunga *Tragelaphus spekei* and Slender-snouted Crocodile *Crocodylus cataphractus* (Anon. 1994a,b, Jones & Hill 1994a). However, it is recognised that additional research is needed to establish more precise population numbers and distribution patterns of these species. This paper focuses on Shoebill and is based on field work on the ground in 1995, aerial transect counts in November 2001, subsequent visits in 2002–03 and a review of the existing literature.

Study area

A large part of the Malagarasi ecosystem was included in the Malagarasi-Muyovozi Ramsar sites with the notable exception of the outlet of the Malagarasi River into Lake Tanganyika. The site includes a number of permanent rivers, such as the Moyowosi, Nikonga, Kigosi and Igombe in the north-east, the Malagarasi in the north and the Ugalla in the south-east, and adjacent floodplains. The rivers meet in a central area, where the lakes Sagara (328 km^2) and Nyamagoma (53 km^2) are located (Tanzania Wildlife Research Institute 2002). From the lakes the water flows west for *c.*100 km as the Malagarasi River, until it forms a delta when flowing into Lake Tanganyika. The

Malagarasi watershed forms *c.*30% of the Lake Tanganyika catchment (Tanzania Wildlife Research Institute 2002) and is the second-largest river basin in Tanzania after the Rufiji. Three game reserves lie within the Ramsar site: Ugalla (5,000 km^2), Kigosi (9,000 km^2) and Moyowosi (11,000 km^2). There are no legal settlements in the game reserves and access is limited to trophy hunting by foreign tourists. Seasonal fishing and beekeeping by local communities are undertaken in Ugalla via a dispensation from the Wildlife Division. During an aerial survey in 2001, in which the authors participated, it was estimated that only 13% of the Ramsar site constitutes wetland habitats: open water (lakes and rivers) 0.6%, permanent swamp 3.2% and seasonally inundated grassland 9.2% (Tanzania Wildlife Research Institute 2002). Thus the site comprises mainly Miombo woodland (*Julbernardia–Brachystegia*: 65%), with pockets of riverine forests and *Combretum* and *Acacia* bushland. The extent of papyrus swamps was estimated at 480–900 km^2 (Tanzania Wildlife Research Institute 2002), which is far less than the previously proposed figure of 2,000 km^2 (Anon. 1994b). Permanent swamps were estimated at 1,335 km^2 (based on an aerial transect survey) or 1,625 km^2 (based on 1:250,000 land cover maps prepared from satellite images) (Tanzania Wildlife Research Institute 2002). A previous estimate of 3,200 km^2 for the northern Moyowosi and Kigosi Game Reserves alone again appears to be a considerable overestimate.

Material and methods

Ground survey in 1995

The major wetlands in Tanzania were surveyed by 17 teams in 1995 in the first comprehensive waterbird count in the country (Baker 1996), which included the first ground-based waterbird survey of the eastern part of the Malagarasi ecosystem.

Aerial surveys in 1971 and 1990s

The population of Shoebill in Malagarasi was first estimated by an aerial survey in 1971 (Parker 1984). In the 1990s it was estimated by aerial surveys using Systematic Reconnaissance Flights (Tanzania Wildlife Conservation Monitoring 1991, 1998, 1999 and unpubl., Jones & Hill 1994a) and the methodology described in Norton-Griffith (1978). These surveys were undertaken by TWCM in the Moyowosi and Kigosi Game Reserves during counts of large mammals and were not specifically designed for Shoebill. However, specific attention was paid to Shoebill and Wattled Crane during surveys in September 1990, November 1992 and June 1993, and a helicopter was used in the 1992 counts in some of the areas (observers unknown, Jones & Hill 1994a). The surveys in the 1990s are difficult to compare with each other and impossible to compare with other surveys because of the wide variation in methodology, observer expertise, areas covered and areas used for extrapolation (Jones & Hill 1994a).

Aerial survey in 2001

The Ramsar site, covering the vast majority of the Malagarasi ecosystem, was surveyed on 17–28 November 2001, at the end of the dry season, when water levels were at their lowest. A Systematic Reconnaissance Flight (SRF) was conducted with two Cessna 182 aircraft flying at a nominal altitude of *c.*100 m (actual range *c.*60–300 m) and a mean speed of 200 km/h. Norton-Griffiths' (1978) methodology was used. A total 76 transects with a total length of *c.*8,000 km were flown. Transects were spaced 5 km apart. Both aircraft flew *c.*6–7 hrs per day, including an average of 1.5–2.0 hours to and from base. One skilled birder operated as rear-seat observer in each of the two planes (M. Baker and J. Anderson); the other rear-seat observer was a member of the TWCM unit specialised in counting mammals. Observations were limited to the strip of land visible between two markers attached to the wing struts. Each transect was divided in sub-units of 30 seconds. The rear-seat observers recorded all wildlife, selected bird species and human activities in a small tape-recorder. These data were subsequently transcribed onto data sheets and analysed using Herd Count 2000 software developed for SRF surveys. However, the combined total area of the observation strips of the two aircraft for all sampled transects covered only *c.*6–7% of the Ramsar site. The counts were extrapolated to cover the whole survey area using Jolly's Method 2 of Unequal Sized Units (Jolly 1969) including the 95% confidence intervals. Incomplete transects were not included in the final data analysis. Surveys in the 1990s used a

similar census and data analysis methodology. Additionally, L. Dinesen undertook an opportunistic morning and afternoon count at the end of the survey in some selected core areas for Shoebill, and had spent 14 days counting waterbirds in Malagarasi in January 1995.

Results

The surveys in the Malagarasi ecosystem between 1972 and 2001 involving Shoebill counts can be grouped into six categories. All Shoebill counts are summarised in Table 1.

1) An aerial count in 1971 (Parker 1984), which estimated the Shoebill population at 'more than 300 birds' within an estimated 200 km^2 of suitable habitat.
2) Six aerial wildlife counts (SRF) undertaken by TWCM between 1990 and 2000 aimed at estimating large-mammal populations in Moyowosi and Kigosi Game Reserves. All Shoebills or cranes were also counted. Population estimates vary from 2,260 Shoebills in 1990 to 235 in 1998 following massive extrapolations. However, the areas covered by the surveys varied from 3,771 km^2 to 21,870 km^2 and so does the extent of Shoebill habitat used as the basis for the extrapolations.
3) The survey in 2001 of the 32,500 km^2 Ramsar site, using similar methods as under 2 and resulting in an estimate of 134 Shoebills.
4) A total count in 1992 carried out by helicopter with specific focus on Shoebill and Wattled Crane. The presumed core areas were covered and 578 birds counted (Jones & Hill 1994a). Extrapolation resulted in an estimated population of 2,489 birds, the highest estimate for the Malagarasi.
5) A ground count of accessible swamps in the eastern part around Lakes Sagara, Nyamagoma and Masimba as part of the nationwide wetlands survey in 1995 (Baker 1996). This produced 44 Shoebills, with concentrations in Lumbe and Masimba.
6) A rapid one-day aerial count in November 2001 in perhaps less than half of the expected Shoebill core areas produced 56 birds.

The surveys in 1971, 1992 and 2001 (Parker 1984, Jones & Hill 1994a, this study) and ground surveys in 1995 (Baker 1996) revealed, unsurprisingly, a clumped distribution of Shoebills, often located in 'bays' of permanent grassland swamps (not papyrus) fringed by Miombo woodland. Based on these surveys the key areas for Shoebill in Malagarasi are largely known.

Table 1. Shoebill numbers recorded and estimated during aerial surveys in the Malagarasi ecosystem 1971–2001.
Tableau 1. Nombre de Becs-en-sabot du Nil *Balaeniceps rex* comptés et estimés pendant les comptages aériens dans l'écosystème de Malagarasi en 1971–2001.

	1971	1990	1992	1993	1994	1995	1998	2000	2001	2001
Estimate	**300+**	**2,258**	**2,489**	**1,028**	**689**	**723**	**235**	**997**	**134**	**none**
SE		±899	±642	±443	±241	±102		±296	±46	
Actual count		**78**	**578**	**35**	**45**	**61**	**15**	**136**	**9**	**56**
Time of year	Aug	Sep	Nov	June	Wet	Dry	May	Dry	Nov	Nov
Areas covered*	SA	GRs	SA	GRs	GRs	GRs	GRs	GRs	RS	SA
Method**	TC	SRF	TC	SRF	SRF	SRF	SRF	SRF	SRF	TC
Area covered (km≈)		20,183	2,125	4,188	21,870	3,771	21,870	21,666		

Sources: 1971: Parker (1984); 1990: Tanzania Wildlife Conservation Monitoring (1991); 1992: Jones & Hill (1994a,b); 1993: Jones & Hill (1994a,b); 1994: Tanzania Wildlife Conservation Monitoring unpubl. via Baker (1996); 1995: Tanzania Wildlife Conservation Monitoring unpubl. via Baker (1996); 1998: Tanzania Wildlife Conservation Monitoring (1999); 2000: unpubl.; 2001: Tanzania Wildlife Research Institute (2002).

* GRs = Moyowosi/Kigosi Game Reserves; RS = Malagarasi-Muyovozi Ramsar Site; SA = Specific Areas, considered to be core areas for Shoebill. ** SRF = Transect count; TC = Total count.

Figure 1. Fisherman in Lumbe swamp, Malagarasi; the number of users in the Malagarasi floodplains has increased dramatically in recent decades placing natural resources under pressure (Lars Dinesen)

Un pêcheur dans le marais de Lumbe, Malagarasi; l'augmentation importante du nombre d'utilisateurs des zones humides de Malagarasi pendant les dernières décennies constitue une menace pour les ressources naturelles (Lars Dinesen)

Figure 2. The survival of Shoebill *Balaeniceps rex* in Malagarasi requires 'realistic' conservation planning, education and awareness-raising, and a portion of luck (Lars Dinesen)

La survie du Bec-en-sabot *Balaeniceps rex* à Malagarasi dépend de la planification réaliste des actions de conservation, d'éducation et de sensibilisation, et une part de chance (Lars Dinesen)

Figure 3. Shoebill *Balaeniceps rex* has been brought to the brink of extinction within *c.*150 years since explorers reached the interior of the continent (Lars Dinesen)

Environ 150 ans après l'arrivée des explorateurs dans l'intérieur du continent, le Bec-en-sabot *Balaeniceps rex* est au bord de l'extinction (Lars Dinesen)

Discussion

The Malagarasi Shoebill population

The variation in estimated numbers (ranging from 134 in 2001 to 2,489 in 1994) prompts two questions: (1) What is the actual population size of Shoebill in the Malagarasi? and (2) What is the population trend since the first survey in 1971. Moreover, it seems crucial to know whether seasonal movements to areas outside the Malagarasi ecosystem could explain the variation, as suggested by Jones & Hill (1994a).

There are no indications of migration out of Malagarasi. Although there are sightings of Shoebills outside the Malagarasi ecosystem (Baker 1996, Tanzania Wildlife Research Institute 2002) and outwith other possible breeding grounds in Tanzania, e.g. the Kagera and Mara swamps, there is no evidence for regular seasonal migration, neither from this nor from other localities (Guillet 1978, Brown *et al.* 1982, Elliott 1992). However, it is expected that birds make local movements in relation to seasonal flooding regimes, food availability and disturbance. A study in southern Sudan by Guillet (1978) found that birds move seasonally between nesting and fishing sites, according to the flood regime. Odd records in Tanzania are more likely caused by adverse situations, e.g. birds leaving their home range in dry years due to extensive fires. Under the reasonable assumption that the bulk of Shoebills is confined to the Malagarasi ecosystem we think that the extrapolated numbers (under points 2 and 3) are crude at best. The basis for extrapolation over such large areas is thin because the distribution of Shoebill is discontinuous in space and time. The actual numbers counted are small (9–136 in six surveys) and the surface area used for extrapolation follows protected area boundaries rather than the extent of suitable habitat. Moreover, there are

major differences in observer skills and most counts were undertaken as part of large-mammal surveys.

A total count attempted partly by helicopter in 1992 resulted in 578 birds counted (Jones & Hill 1994a) and densities reported of 5 birds/km^2 in an area of 65 km^2 and a estimated total of 2,489 individuals. These figures appear crude because Shoebill is considered to be a solitary bird (Brown *et al.* 1982, Elliott 1992, Collar 1994). Parker (1984) estimated 0.64 Shoebills/km^2 in suitable habitat in Moyowosi in 1971. Howard & Aspinwall (1984) counted 23 singles and five pairs in the Bangweulu swamps in Zambia during a Lechwe *Kobus leche* survey. The sightings by the authors in 1995 (44 birds) and 2001 (65 birds) in Malagarasi were of singles or pairs, although a clumped distribution was observed. The densities of other large swamp birds such as Wattled Crane and Saddle-billed Stork *Ephippiorhynchus senegalensis* in prime habitat in the Okavango, Botswana, were 0.12 and 0.10 per km^2 respectively (Craig & Gibson 2001). We therefore suggest a survey designed specifically for Shoebill based primarily on total counts and conducted by experienced birdwatchers (see Appendix).

There has been a huge expansion of human activities in Malagarasi in recent decades (Mutch 1977, 1980, Anon. 1994a,b, Jones & Hill 1994a,b, Tanzania Wildlife Conservation Monitoring 1998, Tanzania Wildlife Research Institute 2002) and a decline in Shoebill population is to be expected. The species is specialised in both its feeding and nesting habits, and vulnerable to disturbance. It requires special fishing sites with solid platforms, standing water, plenty of fish and long periods of undisturbed fishing in order to secure adequate quantities of food (Guillet 1978). Information from the Sudd indicates that the bird is intolerant of even a low level of human disturbance (Guillet 1978). In Malagarasi large areas of Miombo woodland adjacent to the swamps are being cleared for tobacco farming and agriculture, and the human population, consisting of farmers, fishermen, refugees and semi-nomadic Watutsie pastoralists, has increased very rapidly in recent decades. Hunting companies reported that the annual dry-season burnings and cattle grazing in the core area of the Shoebills (southern Moyowosi and Kigozi) are severe and expanding. The first rice paddies were seen to appear at the edge of key Shoebill swamps. However, quantitative land use data are lacking. Guillet (1978) considered fire and cattle to be the main threats in the Sudd. There are no data on breeding success from Malagarasi, but it is of concern that the long-living Shoebill has a low reproduction rate and non-productive populations may exist for decades in formerly productive areas.

Global conservation status

The Shoebill's main global stronghold is the Sudd swamps in southern Sudan, where a total of 6,407 birds was counted in 1979–82 (Robertson 2001). Guillet (1978) warned that the rapid growth of the human population jeopardised the survival of Shoebill here. A serious additional threat is the planned Jonglei canal, which will drain a large part of the swamp. Uganda has *c.*400–600 birds, confined mainly to papyrus swamps (Elliott 1992). A cautious estimate of the populations in western Tanzania (Malagarasi) and northern Zambia (Bangweulu) gives not more than a few hundred birds for each site (Howard & Aspinwall 1984, Collar 1994, Leonard 2001, this study) and both populations are under increasing pressure. The populations in Mara in Tanzania, Akagera in Rwanda/Tanzania, and localities in eastern DR Congo are much smaller and, in the latter sites, under significant pressure due to the civil unrest (Kanyamibwa 2001). In sum, the handful of core Shoebill populations are under increasing threat due to disturbance, conversion of swamp habitat and locally from collectors (see also Elliott 1992 for a review) and nowhere is its survival secure. We therefore strongly support the upgrade of its global conservation status from Near Threatened (BirdLife International 2000) to Vulnerable (VU C1) (IUCN 2001, BirdLife International 2004) i.e. a population of fewer than 10,000 mature individuals and a decline of more than 10% in three generations. Although there is no hard evidence for a 10% decline, empiric reports from the core localities indicate a serious and steady decline in all sub-populations. More importantly, conservation actions should target the few key wetlands in Zambia, Tanzania, Uganda and Sudan where the species has a reasonable chance to survive.

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Appendix 1. Proposed survey design
Annexe 1. Protocole pour les comptages aériens futurs

All Shoebill observations by the authors (N=109) in the Malagarasi ecosystem have been in waterlogged grassland. The stronghold is the permanent swamp areas formed by the Moyowosi, Nikonga and Gombe Rivers in and south of the Kigosi and Moyowosi Game Reserves (Jones & Hill 1994a,b). We recommend aerial surveys using a stratified approach with a high focus on total counts in the permanent swamps and floodplains of the ecosystem. This should be possible within one or two weeks, depending on the season and keeping in mind that the maximum extent of Shoebill habitat is *c.*4,225 km^2 and the area of permanent swamp *c.*1,040 km^2. Because Shoebill is dependent on water for both feeding and nesting, only the waterlogged plains need to be surveyed. At the end of the wet season, in April–May, a large area is flooded and this coincides with the expected breeding time. Shoebill has been recorded breeding in Malagarasi on a few occasions (Jones & Hill 1994a,b). Pre-count reconnaissance flights using a few days should be undertaken to potential Shoebill areas before a final decision on specific count areas is taken. Flight transects should be *c.*500 m apart (Craig & Gibson 2001) and flights should be at *c.*250 m altitude in a high-winged aircraft. In Malagarasi individual count areas should follow the different floodplains. Count areas in key areas should be covered 100% and, depending on the resources, count categories could perhaps be planned with 50% (each second line) and as a minimum of 25% (each fourth line) coverage respectively. However, it is recommended as a minimum that half the survey area is covered 100%. Two skilled birdwatchers should be rear-seat observers and record Shoebills on a dictaphone, while a front-seat observer would record the count area codes and coordinates of all end points. Attempts to count other waterbirds or mammals should be avoided. In the data analysis of the Wattled Crane population in the Okavango, Jolly's (1969) method for sample units of unequal size was used to calculate estimates of density and variance (Craig & Gibson 2001), and a similar method should be used in the analysis of the 50% and 25% sampled count areas. Surveys should be undertaken in both the dry and wet seasons, and indication of breeding should be noted (expected to be in the peak wet season, in April/May onwards).